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1 542 095

(54) AEROSTAT

(71) I, ROBERT ARMAND CREUZET, a citizen of France, of Route de Beyssac, 47200 Marmande, France, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to an aerostat.

Aerostats are known, which include an envelope containing hot air, and a heating burner provided below a lower opening in the envelope.

These aerostats are operable in a simple and economical manner.

But, heretofore, it has not been possible to use them as captive balloons. When such an aerostat is restrained by a cable the envelope, having no internal pressure is flattened out under the action of even a relatively slight wind, causing partial deflation, and consequently descent, of the aerostat.

Up to now, captive balloons have included an envelope enclosing a gas lighter than air, such as hydrogen or helium. The use of such balloons is costly because of the price of the gas.

This invention provides a hot air aerostat comprising an envelope; a closable valve member disposed in the lower part of said envelope, said envelope and valve member defining a substantially closed air space when said valve member is in its closed state; a gondola or nacelle attached to said envelope; and a burner disposed inside said air space to heat the air contained in said envelope.

The envelope of the aerostat can then be a closed envelope and, in use as a captive balloon, the hot air aerostat remains inflated even when subjected to the action of the wind.

The burner inside the envelope is preferably a gas burner and is connected to a fuel reserve carried in the gondola or nacelle of the aerostat.

This nacelle is provided with means for remotely controlling ignition of the inflammable gas.

In a first embodiment, the aerostat comprises a means for introducing the inflating air into the envelope. After this inflating phase that the air introduced is heated by the means inside the envelope.

The introduction is preferably made by means of a flexible sleeve member which rises under the effect of the air driven in during the inflating phase and which, collapsing when the driven in ceases, restores the continuity of the closed enclosure which the envelope constitutes.

The invention also has for its object, as an alternative, a hot air aerostat with a closed enclosure containing air heated during filling or inflating thereof.

According to another alternative, air is only preheated during filling to insure the rising of the envelope and the complementary heating for ascension is provided by the burner inside the envelope.

An aerostat according to this invention further comprises, preferably, an upper valve the opening of which enables the hot air to discharge upon command from the nacelle, for descent, and one or several lower valves for discharge of carbon dioxide, if necessary. The atmosphere required for a good combustion of the fuel is thus maintained inside the envelope.

Another upper valve is provided, to open automatically, to prevent any overpressure inside the envelope.

This invention also has for its object an embodiment characterized by the fact that the enclosure for hot air is limited on one hand, by the flexible envelope of the aerostat and on the other hand, at the lower end, by a platform for various uses and which essentially supports means enabling the filling of the envelope with air and also the burner for heating the air.

In another embodiment, the burner is carried by an extensible device, in such a manner that, being substantially at the height of the platform when not in use, it is raised in order to heat the air inside the envelope.

The invention provides that the raising of the burner is caused by means, such as

springs, which become taut during the lowering back of the device.

According to another characteristic of this invention, the platform comprises also valve means to evacuate hot air. The construction of the balloon is thus simplified and its efficiency increased.

Whereas, it is usual to retain the captive balloon, specially a spherical balloon, by means of a cable attached to the nacelle, the invention provides a securing means removed laterally from the axis of the balloon and preferably at a level higher than that of the nacelle.

In another embodiment, the equipment platform carries a rail or horizontal bar, at the extremity of which is provided a fastening means.

The fastening means is preferably mounted in sliding relationship along the rail, which enables it to be moved towards the axis of the balloon when it is desired to haul the balloon towards the ground.

A rail or bar depending from the platform is provided for other uses, such as securing of observation means, and securing for a releasing operation.

The following description, given as an example, refers to the accompanying drawings, in which:

Figure 1 is a schematic view of an aerostat;

Figure 2 is an elevation of an aerostat in another embodiment;

Figure 3 is an elevation at a larger scale of a portion of the platform with the devices it sustains;

Figure 4 is a schematic perspective view of the platform and of the erectible device carrying the burner;

Figure 5 is a schematic view illustrating the operation of the elevating device;

Figure 6 is a schematic plan view of the platform;

Figure 7 is a schematic plan view of a portion of the device; and

Figure 8 is a schematic plan view of a portion of the burner support.

Reference is first made to Figure 1. The aerostat, there shown, comprises an envelope 11 preferably in nylon cloth. From the envelope for example from the lower end, a suspender means 12 supports a nacelle 13. This nacelle accommodates a fan and motor combination 14 which comprises a motor, for example fuelled by petrol, gas or oil, and the shaft 16 of which, vertical, or horizontal with a bevel gear, drives a fan rotor 17 within a screen 18. The screen is secured to a load ring 21 to which is fastened the lower opening of the envelope. On the load ring 21 is also fastened, a cylindrical air sleeve 19, in nylon cloth or a similar material.

The nacelle 13 also accommodates a fuel reserve, for example bottles 22 of liquid propane. From the fuel reserve flexible pipes 23, 24, 25 lead to rings 26, 27, 28 of a burner 29, the valves 31 enabling to feed as desired one or more rings 26—28. For the sake of clarity of the drawing, the flexible pipes 23 to 25 have not been shown extended to the bottle 22.

An ignition means 35 is part of the burner and is connected by a conductor 36 to an electric source 37, the ignition control being provided by a button 38.

The burner 29 is suspended by cables 30 from an upper ring 32 which is part of the sustaining structure of the envelope, and secured by other cables fastened to a lower ring of the structure. The cables also carry a screen in metal gauze or perforated sheet metal and closed at its upper end by an end portion 34, also in metal gauze, to arrest the flame of the burner. Another metal screen, of hemispherical shape, 39, in metal grating or metal gauze is provided to protect the envelope during inflation or when it collapses on landing.

The burner and the screen are placed inside the envelope significantly below the equatorial plane of the latter.

A valve 41 is provided at the upper end of the envelope and operable from the nacelle by means of a cable 42. Another valve 43 is part of the valve 41 and operates automatically, opening whenever the internal pressure of the envelope exceeds a predetermined value.

One or several valves 44 are provided at the lower end of the envelope, in the neighbourhood of the junction of the envelope with the ring 21.

To inflate the aerostat, the motor of the fan motor combination 14 is turned on. Air taken in from outside is driven by the fan 17, into the envelope through the sleeve 19 which rises under the effect of the air flow. The envelope, initially spread and collapsed on the nacelle 13, fills progressively with air, at a temperature slightly greater than that of the surrounding air if the exhaust gases from the motor are simultaneously driven into the sleeve member.

When the envelope has reached a predetermined degree of inflation, the volume attained being about $\frac{3}{4}$ of the final volume, the motor is stopped; air is no longer driven in and the sleeve member 19 subsides falling back onto the bottom of the envelope, closing the passageway between the inside of the envelope and the external atmosphere.

The burner 29 is fed, and the ignition of the inflammable gas is obtained by means of the electrical spark igniter 35, simply by pressing button 38. For this phase, two of the burner rings are fed with inflammable gas. By combustion of the gas inside the enclosure which constitute by the envelope the air contained inside the envelope is rapidly heated.

After casting off the mooring ropes, the balloon rises under the effect of the buoyancy force developed by the hot air contained inside the envelope 11.

Where the aerostat is used as a captive balloon, the aerostat takes with it the cable which is to keep it bound to the ground until it reaches the desired height and in this position it is held by the cable.

The aerostat can fulfill the same functions as a captive balloon filled with a light gas as hydrogen, coal gas or helium, but without the expense resulting from the supply of such gases.

A lateral wind does not cause deflation of the envelope, the enclosure being limited by the fact that envelope is closed.

When it is desired to increase or to maintain the buoyancy force, the burner 29 is reignited; usually only one ring is ignited.

The use of the three rings is provided to enable a faster ascent to be made.

To cause the aerostat to descend, the valve 41 is opened which causes hot air to discharge.

Inside the envelope are provided a certain number of detection means; e.g. thermometers 45, 46, 47, and a detector 51 for transmitting to the nacelle the pressure inside the envelope.

Detection means 52 placed at the lower end of the enclosure and limited by the envelope provides information on the percentage of carbon dioxide at the lower end of the enclosure. When this percentage reaches a predetermined value, the opening of the valves 44 is commanded: the carbon dioxide discharges to atmosphere, in such a way that the composition of the internal atmosphere of the envelope 11, especially in the neighbourhood of burner 29, remains favourable for a good combustion of the heating gas.

Eventually, more fresh air is injected inside the envelope by starting up the fan-motor combination 14.

The presence of a screen 39 of metal gauze or similar material, around the burner, is motivated by safety reasons.

The envelope is of nylon cloth or similar material, having the inner side furnished with a heat-resisting lining, preferably obtained by coating with plastic foam or a product derived from glass fibre.

In an alternative embodiment, the envelope is double-skinned and comprises two layers of nylon cloth or similar material braced either with honeycomb material, or with net weft defining cells filled with air and constituting an insulating matrix.

The heat loss of the air inside the envelope is thus diminished to the benefit of a longer conservation of the buoyancy force.

Reference is now made to Figures 2 to 8; the envelope 101 of the balloon (Figure 2) here has a lower opening 102 surrounded by a pad 103. On the pad 103 there is secured, by a strap 103^1, a circular annular platform 104. This platform (figures 3 and 4) has a frame comprising principally a diametrally extending tube 105 projecting on both sides of the annular plate 106, the latter terminating in a shaped part 107 and constituting the body of the platform. In the opening of the platform there is placed a lower chimney member 108, in which is placed a fan 109 the shaft of which is driven by a pulley 111 on which passes a belt 112 driven by a motor 113 carried by the frame tube 105. On the upper edge 114 of the chimney member 108 is secured the lower end of a flexible air sleeve 115. The upper opening of the chimney member 108 is protected by a grating 116.

The platform 104 carries radially extending rails 121, 122, 123, 124, angularly placed at 90° from each other. The rails 122, 123 serve to guide rollers 61 and 62 onto which are secured in articulated relationship the ends of diagonal bars 63 and 64 (figures 4 and 5) articulated one onto the other in 65, and the other ends 66 and 67 of which are articulated onto two other diagonal bars 68 and 69 articulted one onto the other in 70. These bars constitute a well known mechanical system called Nuremberg scissors or pantograph 71*a*. A first spring is provided between the lower ends 251 and 252 of the bars 63 and 64 and tends to move the rollers 61 and 62 in a direction bringing them closer to the centre of the platform as shown by arrows. A second spring 73 is provided between the ends 66 and 67 and tends to move them towards one another.

A similar kinematic system 71*b* (figure 6) is provided between roller 62 and a roller 74 moving along the rail 124. A third articulated system 71*c* is provided between roller 74 and a roller 75 guided inside rail 121, and a fourth articulated system 71*d* is provided between roller 75 and roller 61.

The upper ends 301 (figure 7) of bar 68*a* of system 71*a* and the adjacent end 302 of bar 69*b* of system 71*b* are secured in pivoting relationship onto the branches 303 and 304 of a bracket 305 integral with a tongue 306. Onto this tongue is secured a diagonal tube 307, the axis of which is in a plane perpendicular to the planes of systems 71*a* and 71*b* and is angularly equidistant from those planes. Into the open end 308 of tube 307 is fitted in sliding relationship a cylindrical rod 309 (figure 8).

A similar configuration is provided at the other junction ends of the kinematic systems 71*b* and 71*c*, 71*c* and 71*d*, 71*d* and 71*a*. The rods 309 constitute then a cross-piece 310 with four arms and it is onto this cross-piece that the burner 133 is secured, with its annexes, especially its ignition means and its protection gratings or shields 134 and 135.

In contracted or collapsed position of the scissors' systems 71, the rollers 61, 62, 74, 75 are towards the external ends of the rails 122, 123, 124 and 121 and the springs 72 and 73 are stretched. When the kinematic systems 71 are released, the action of the springs 72, 73 causes the rollers to move along their respective rails and the parallelogram systems unfolding under the action of the springs, raise the burner 133 automatically. In the course of this movement, the tubes 307 move along the rods 309; at the end of their travel, the external ends 311 of the rods are near the bottom 312 of the tubes 307. In the collapsing condition of the kinematic systems, the ends of the rods 311 are near the ends 308 of the tubes, but still inside them.

The collapsing of the burner, for example for the descent of the balloon, is realized by means of lowering cables at the disposal of the occupants of the nacelle.

A locking means is provided to maintain the device lowered as long as the burner is not in use.

The quadrants of the platform 104 limited by the rails 121—124 are constituted by panels with truncated sector shape 136, 137, 138 (figure 6) which are hinged on their internal rectilinear edges 140, 141, 142, 143 respectively. These panels are subjected to the action of calibrated springs, so that they open automatically and same as valves when the internal pressure of the envelope exceeds a predetermined value, and are adjustable as desired. These panels can also be operated manually from the nacelle 144. The panel 139 on figure 3 is shown schematically in an open position.

The tube 105 serves to maintain two radial rails 151 and 152 diametrally opposed, the length of which rails is such that their ends 153 and 154 are practically aligned with the equatorial extremities of the envelope 101. Sustaining means 155 are provided to sustain rails 151 and 152.

On rail 151 can move a carriage 156 comprising a hook 157 to fasten a cable 158 to retain the balloon. When the carriage 156 is at the end 153 of the rail 151 and the cable 158 is fastened, the effect of the wind on the balloon does not cause the polar axis of the balloon to be greatly inclined; the inclination is less marked than for a balloon fastened to its nacelle, because, on one hand, of the lateral removal of the extremity 153 and, on the other hand, of the elevated position of this extremity relatively to the nacelle.

When it is desired to bring back the balloon to the ground in its inflated state, it is preferable to move the carriage 156 towards the polar axis.

The other rail 152, on which can also move a carriage 156^1 with a hook 157^1, can be used to secure on the carriage observation instruments or objects, or even persons. The release of a man equipped with a kite or a parachute is preferably made at the extremity 154 furthest from the cable 158.

The control of the carriage takes place from the nacelle.

WHAT I CLAIM IS:—

1. A hot air aerostat comprising an envelope; a closable valve member disposed in the lower part of said envelope, said envelope and valve member defining a substantially closed air space when said valve member is in its closed state; a gondola or nacelle attached to said envelope; and a burner disposed inside said air space to heat the air contained in said envelope.

2. A hot air aerostat according to claim 1, wherein said burner is movable vertically between a lowered position, and a raised position in which it is at a distance above the lower part of said envelope, and is operable in said raised position so that its operation is not hampered by heavier-than-air exhaust gases accumulating in the lower part of the envelope.

3. A hot air aerostat according to claim 1 or 2, and including a fan to blow air from the external atmosphere into said envelope through said valve member, said valve member comprising a flexible sleeve member having one end registering with an aperture in said envelope, and being extendible into said volume of air upon activation of said fan.

4. A hot air aerostat according to claims 2 and 3, wherein, in the raised position of said burner, and when said sleeve member is extended into said volume of air, the upper end of said sleeve member is adjacent to said burner in its operational state.

5. A hot air aerostat according to claim 2, 3 or 4, wherein said burner is a gas burner and is suspended by suspension cables attached to said envelope.

6. A hot air aerostat according to claim 2, 3 or 4, further comprising an erection device supported by a rigid member defining said aperture in the envelope, being positionable in stored and operational positions, said burner being supported by said erection device to be located in said stored position in the vicinity of said aperture and elevated above said aperture in said raised position.

7. A hot air aerostat according to claim 6, wherein said erection device comprises several bars arranged in a pantograph configuration.

8. A hot air aerostat according to claim 6 or 7, wherein said rigid member is an annular planar platform having a plurality of apertures, and further comprising a plurality of valves for closing respective said apertures, said valves opening to the atmosphere when the pressure inside said envelope increases above a predetermined level.

9. A hot air aerostat according to any

one of the preceding claims, and including a fuel tank disposed in said nacelle or gondola, said fuel tank being connected to said burner; and ignition means disposed in the vicinity of said burner.

10. A hot air aerostat according to any one of the preceding claims, wherein the aerostat has a radially extending arm; wherein said envelope is balloon-shaped when inflated and has a neck-ring, carrying means for linking said neck-ring to said radially extending arm, and support means linking said radially extending arm to a point of the envelope situated near the equatorial line of the balloon; and wherein a carriage is slidably mounted on said radially extending arm for receiving anchoring means to anchor the aerostat.

11. A hot air aerostat according to any one of claims 1 to 9, wherein the aerostat has a radially extending arm; wherein said envelope is balloon-shaped when inflated and has a neck-ring, carrying means for linking said neck-ring to said radially extending arm, and support means for linking said radially extending arm to a point of the envelope situated near the equatorial line of the balloon; and wherein a carriage is slidably mounted on said radially extending arm for carrying a load.

12. An aerostat substantially as hereinbefore described with reference to and as shown by Figure 1 of the accompanying drawings.

13. An aerostat substantially as hereinbefore described with reference to and as shown by Figures 2 to 8 of the accompanying drawings.

J. A. KEMP & CO.,
Chartered Patent Agents,
14, South Square,
Gray's Inn,
London WC1R 5EU.

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1542095 COMPLETE SPECIFICATION
6 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

Fig. 1

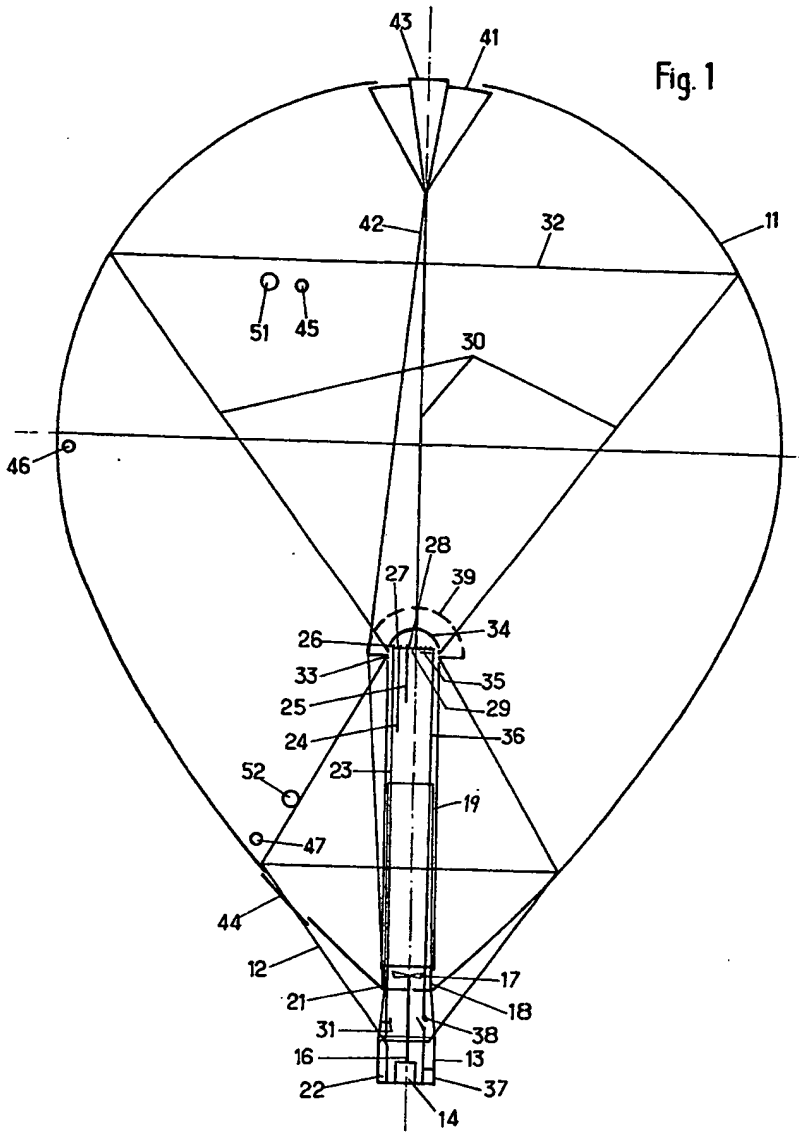

Fig. 2

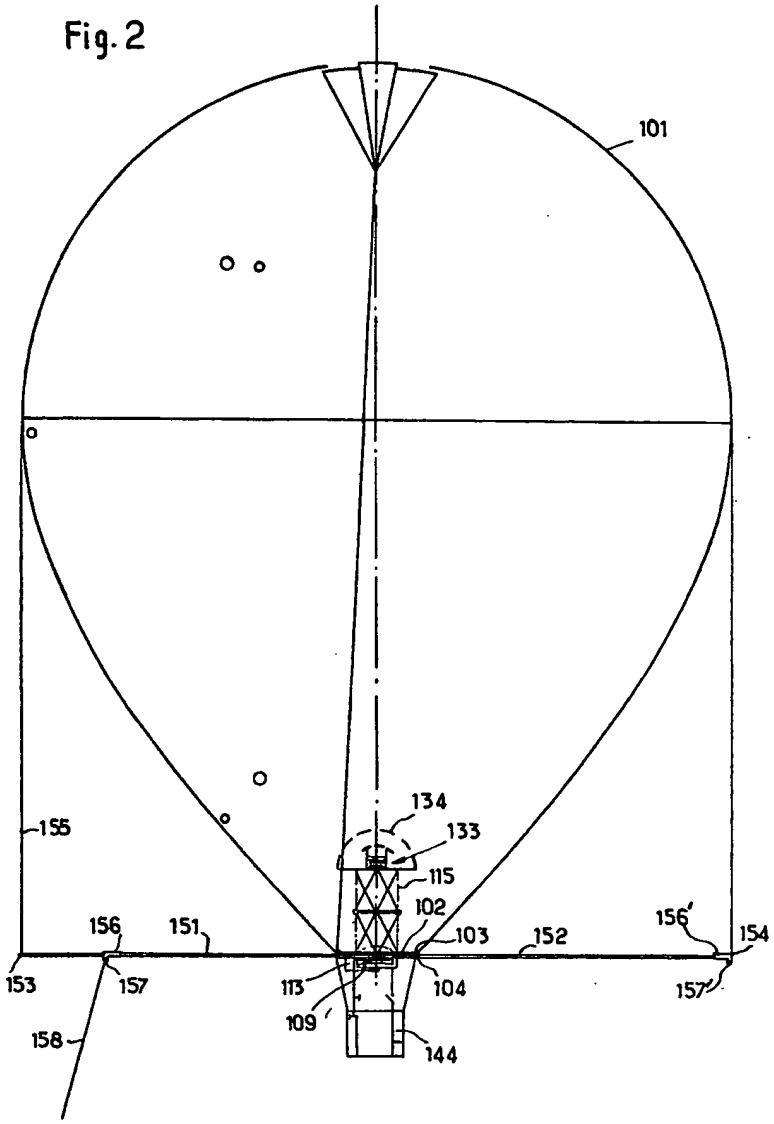
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Fig.3

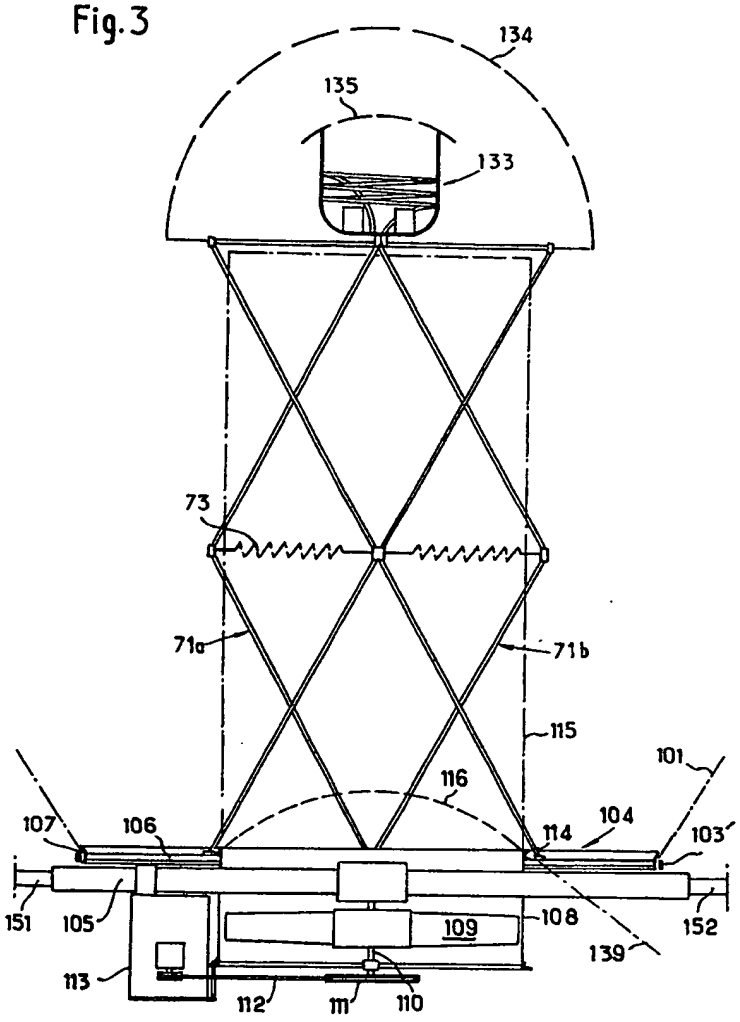
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Fig. 4

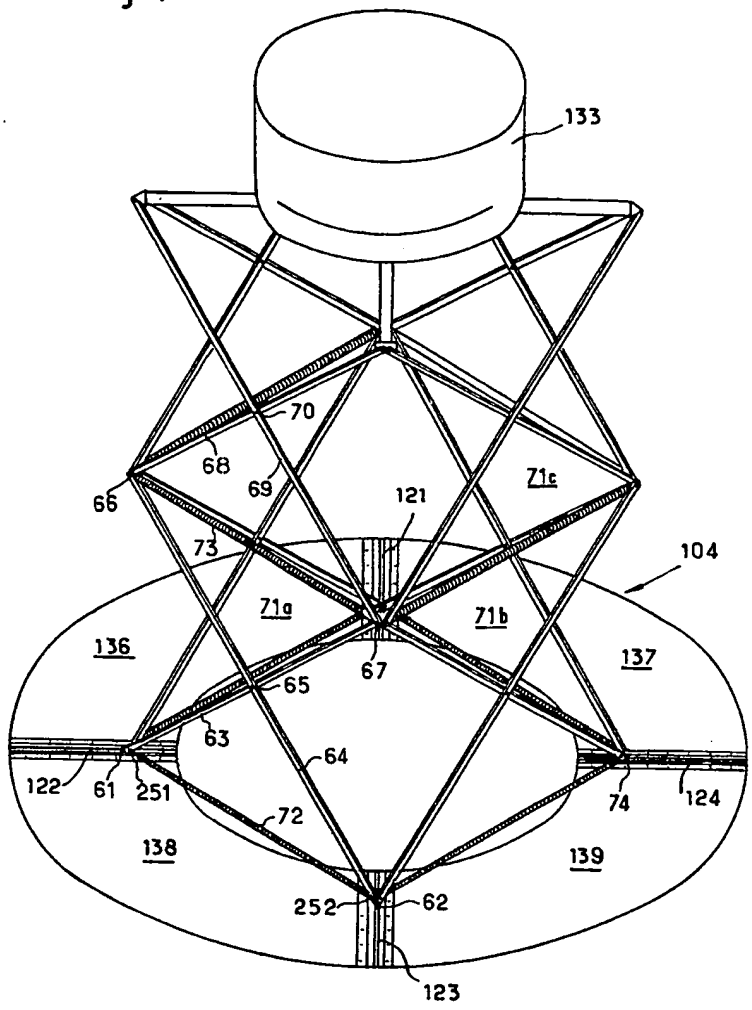
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Fig.5

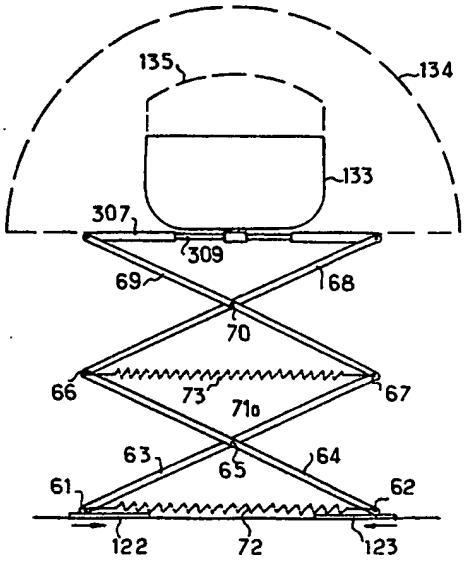
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Fig.6

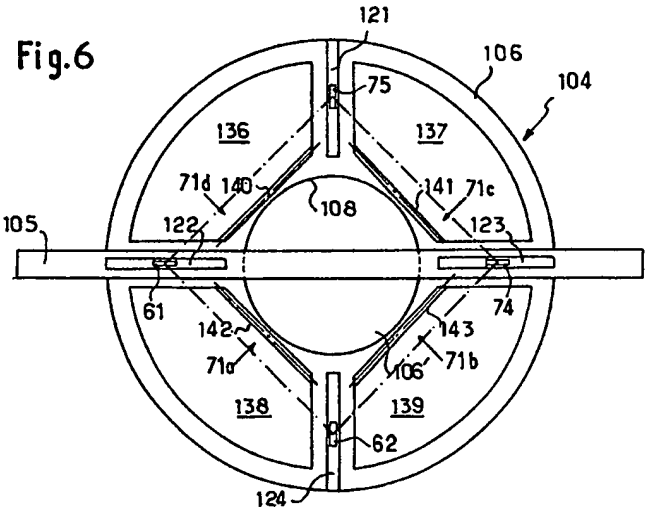
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Fig. 7

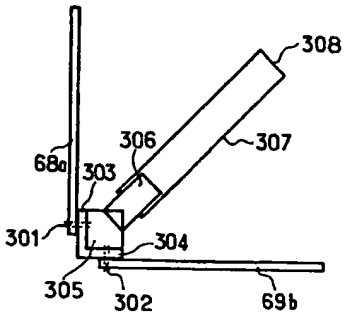

Fig. 8